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For: INTEGRATED ELECTROFLUIDIC SYSTEM AND METHOD.

1           1.     An integrated electrofluidic system comprising:  
2                     an electronic control system mounted on a support platform;  
3                     a microfluidic system embedded in said platform and having an input and  
4     an output and at least one electrofluidic component; and  
5                     at least one electrical conductor carried by said platform for electrically  
6     interconnecting said electronic control system and said at least one electrofluidic  
7     component.

1           2.     The integrated electrofluidic system of claim 1 in which said platform  
2     includes a plurality of laminated layers forming said embedded microfluidic system.

1           3.     The integrated electrofluidic system of claim 1 in which said platform  
2     includes a polyimide material.

1           4.     The integrated electrofluidic system of claim 1 in which said platform  
2     includes KAPTON®.

1           5.     The integrated electrofluidic system of claim 2 in which said layers are  
2     laminated using a phenolic resin adhesive.

1           6.     The integrated electrofluidic system of claim 5 in which said phenolic

2 resin adhesive is R/FLEX<sup>®</sup>.

1 7. The integrated electrofluidic system of claim 5 in which said phenolic  
2 resin adhesive is etched to a thickness of 3 to 10  $\mu\text{m}$ .

1 8. The integrated electrofluidic system of claim 5 in which said phenolic  
2 resin adhesive is selectively removed from regions where bonding is undesirable between  
3 said layers and/or between a said layer and said electrofluidic component and/or a  
4 microfluidic component.

1 9. The integrated electrofluidic system of claim 1 in which said microfluidic  
2 system includes a valve.

1 10. The integrated electrofluidic system of claim 1 in which said microfluidic  
2 system includes a pump.

1 11. The integrated electrofluidic system of claim 1 in which said microfluidic  
2 system includes a reservoir.

1 12. The integrated electrofluidic system of claim 1 in which said microfluidic  
2 system includes a mixer.

1 13. The integrated electrofluidic system of claim 1 in which said microfluidic

2 system includes at least one channel.

1 14. The integrated electrofluidic system of claim 1 in which said microfluidic  
2 system includes a filter.

1 15. The integrated electrofluidic system of claim 1 in which said microfluidic  
2 system includes a dispenser.

1 16. The integrated electrofluidic system of claim 1 in which said microfluidic  
2 system includes a reactor.

1 17. The integrated electrofluidic system of claim 1 in which said microfluidic  
2 system includes a heater.

1 18. The integrated electrofluidic system of claim 1 in which said microfluidic  
2 system includes a concentrator.

1 19. The integrated electrofluidic system of claim 1 in which said microfluidic  
2 system includes a pressurizing device.

1 20. The integrated electrofluidic system of claim 1 in which said microfluidic  
2 system includes a cooling device.

1           21.     The integrated electrofluidic system of claim 1 further including a sensor  
2     device integrated with said microfluidic system.

1           22.     The integrated electrofluidic system of claim 21 in which said sensor  
2     device is embedded in said platform.

1           23.     The integrated electrofluidic system of claim 21 in which said sensor  
2     device includes a flexure plate wave sensor.

1           24.     The integrated electrofluidic system of claim 21 in which said sensor  
2     device includes a photoelectric sensor device.

1           25.     The integrated electrofluidic system of claim 21 in which said sensor  
2     device includes an optical sensor device.

1           26.     The integrated electrofluidic system of claim 21 in which said sensor  
2     device includes an electrochemical sensor device.

1           27.     The integrated electrofluidic system of claim 21 in which said sensor  
2     device includes a temperature sensor device.

1           28.     The integrated electrofluidic system of claim 21 in which said sensor  
2     device includes a pressure sensor device.

1           29.    The integrated electrofluidic system of claim 21 in which said sensor  
2           device includes a flow sensor device.

1           30.    The integrated electrofluidic system of claim 21 in which said sensor  
2           device includes a viscosity sensor device.

1           31.    The integrated electrofluidic system of claim 21 in which said sensor  
2           device includes a mass sensor device.

1           32.    The integrated electrofluidic system of claim 21 in which said sensor  
2           device includes a magnetic sensor device.

1           33.    The integrated electrofluidic system of claim 21 in which said sensor  
2           device includes an acoustic sensor device.

1           34.    The integrated electrofluidic system of claim 1 further including a  
2           dispenser device integrated with said microfluidic system.

1           35.    The integrated electrofluidic system of claim 1 further including a heat  
2           exchange device integrated with said microfluidic system.

1           36.    The integrated electrofluidic system of claim 34 in which said dispenser  
2           device includes a drug delivery device.

1           37.    The integrated electrofluidic system of claim 1 further including a fuel cell  
2    device integrated with said microfluidic device.

1           38.    An integrated electrofluidic system comprising:  
2                    an electronic control system mounted on a support platform;  
3                    a microfluidic system embedded in said platform and having an input and  
4           an output and at least one electrofluidic component;  
5                    at least one electrical conductor carried by said platform for electrically  
6           interconnecting said electronic control system and said at least one electrofluidic  
7           component; and  
8                    a sensor integrated with said electrofluidic system.

1           39.    The integrated electrofluidic system of claim 38 in which said platform  
2           includes a plurality of laminated layers forming said embedded microfluidic system.

1           40.    An integrated electrofluidic system comprising:  
2                    an electronic control system mounted on a support platform;  
3                    a microfluidic system embedded in said platform and having an input and  
4           an output and at least one electrofluidic component;  
5                    at least one electrical conductor carried by said platform for electrically  
6           interconnecting said electronic control system and said at least one electrofluidic  
7           component; and  
8                    a dispenser device integrated said electrofluidic system.

1           41.    The integrated electrofluidic system of claim 40 in which said platform  
2           includes a plurality of laminated layers forming said embedded microfluidic system.

1           42.    The integrated electrofluidic system of claim 40 in which said dispensing  
2           device dispenses fluid in the range of about 100 microliters to 100 picoliters.

1           43.    The integrated electrofluidic system of claim 40 in which said dispensing  
2           device dispenses fluid at a rate of about 0.1 to 100 microliters/min.



1           44.    An integrated electrofluidic system comprising:  
2                    an electronic control system mounted on a support platform;  
3                    a microfluidic system embedded in said platform and having an input and  
4           an output and at least one electrofluidic component;  
5                    at least one electrical conductor carried by said platform for electrically  
6           interconnecting said electronic control system and said at least one electrofluidic  
7           component; and  
8                    a heat exchange device integrated with said electrofluidic system.

1           45.    The integrated electrofluidic system of claim 43 in which said platform  
2           includes a plurality of laminated layers forming said embedded microfluidic system.

1           46.    A method for manufacturing an integrated electrofluidic system, the  
2   method comprising:

- 3                   a)     providing a substrate layer having an adhesive layer;  
4                   b)     thinning said adhesive layer;  
5                   c)     machining said adhesive layer and said substrate layer to create  
6   features that define at least one microfluidic component and/or at least one electronic  
7   component;  
8                   d)     aligning said substrate layers;  
9                   e)     laminating the layers to embed said microfluidic component and/or  
10   said electronic component between said layers; and  
11                  f)     repeating steps a) through e) for a predetermined number of layers  
12   of said substrate and said adhesive layer.

1           47.    The method of claim 46 in which said substrate layer is KAPTON®.

1           48.    The method of claim 46 in which said adhesive layer is thinned by plasma  
2   etching.

1           49.    The method of claim 46 in which said adhesive layer and said substrate are  
2   machined by applying an energy beam with a laser.

1           50.    The method of claim 46 in which step a) further includes providing  
2   additional microfluidic component and/or an electronic component to be embedded

3 between said layers.

1 51. The method of claim 46 further including the step of attaching additional  
2 microfluidic components and/or electronic components to the top surface of said  
3 laminated layers.

1 52. The method of claim 46 further including the step of applying a mask to  
2 said adhesive layer to define removal of said adhesive and to further define said  
3 microfluidic components.

1 53. The method of claim 46 in which step a) further includes providing  
2 electrical pads and electrical leads for interconnecting said microfluidic components and  
3 said electronic components.

1 54. The method of claim 46 further including the step of attaching electrical  
2 pads and electrical leads to the surface of said laminated layers.

1 55. The method of claim 49 in which said machining includes raster scanning  
2 to define said features.

1 56. The method of claim 55 further including the step of controlling the depth  
2 of said features by modifying said raster path.

1           57.    The method of claim 46 further including the step of removing residual  
2 carbon and cleaning said substrate layers.

1           58.    The method of claim 46 further including the step of tacking the layers.

1           59.    The method of claim 46 wherein said machining includes depositing and  
2 patterning thin films of material on said substrate layer to form said electronic  
3 components.

1           60.    The method of claim 59 in which said material is chosen from the group  
2 consisting of titanium, chrome, gold, platinum, tungsten, copper and nickel.

1           61.    The method of claim 59 in which said material is plated with a material  
2 including copper.

1           62.    The method of claim 60 further including the step of depositing a thin film  
2 of said material on said substrate layer to form an electric heater.

1           63.    The method of claim 62 further including the step of depositing a thin film  
2 of said material on said substrate layer to form an electric cooling device.

1           64.    The method of claim 46 in which step c) further includes applying a  
2 chemically functional coating to said substrate.

1           65.     The method of claim 64 in which said chemically functional coating is  
2     chosen from the group consisting of: polymers, antibodies, human IgG or animal IgG,  
3     antibody fragments, antigens, antigen fragments, peptides, aptamers, single-stranded  
4     DNA (ssDNA), and biomolecules.